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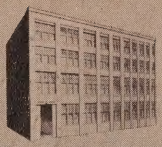

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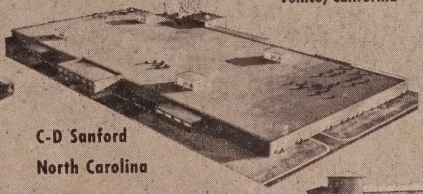

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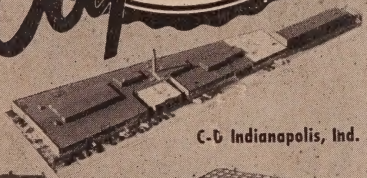

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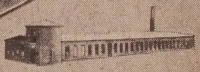

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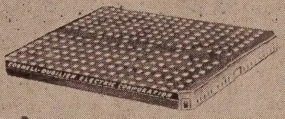

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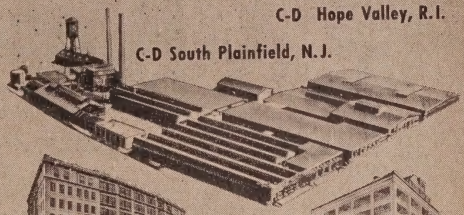

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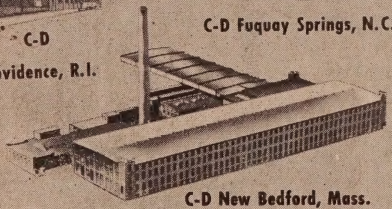

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FERROELECTRICITY AND ITS APPLICATIONS

The quest for amplifying and control devices which possess higher reliability than the vacuum tube has yielded many innovations. Some of these, like the transistor, have been immediately applicable to practical circuits. Others presently are in various stages of improvement or still are laboratory curiosities but give promise of early application.

One property which seems to be undergoing only slow utilization but very likely will yield intriguing components for the electronics of the future is **ferroelectricity.** Research in ferroelectricity is being advanced on many fronts and is receiving a great deal more serious attention than may appear on the surface.

Ferroelectricity Defined

What is ferroelectricity? Briefly, it is a property resulting from non-linear dielectric action. It is exhibited as the unusual characteristic that certain dielectric materials have of changing their dielectric constants with applied voltage. Linear dielectrics, such as the insulants commonly used in electronics, exhibit no such property — at least not to any marked degree.

Voltage-sensitive dielectrics are said to be ferroelectric. Among such materials which have been tested extensively in electronic development are barium titanate, titanium dioxide, guanadine aluminum sulphate hexahydrate (GASH), and triglycene sulphate. There, of course, are many other materials which are ferroelectric to some degree, not always useful. Some materials are both ferroelectric and piezoelectric.

There is no simple yet exact explanation of ferroelectricity outside of the realm of advanced physical chemistry. However, rudimentary physical pictures can impart a practical understanding of the effect. Perhaps, the simplest of these pictures is that an electrostatic field will align electric dipoles in a dielectric in much the same way that a magnetic field aligns magnetic dipoles in a magnetic material.

The mechanism is thought to result from the nature of the dielectric atom. In such atoms, there are very few free electrons. In fact, the number of electrons able to contribute to current flow is infinitesimal, this accounting for the insulating properties of the material. Most of them are bound tightly within the atoms. When an electrostatic field is applied to a dielectric, the atoms are strained or distended, as the bound electrons are pulled toward the positive electric pole. These stretched atoms, with their distorted shapes, are the **electric dipoles.** They line up along the electrostatic lines of force.

In non-linear dielectric materials, the number of aligned dipoles is not a direct function of the applied voltage. This accounts for the fact that the dielectric constant (K) of such materials varies non-linearly with voltage. At a given constant temperature, the K vs. E characteristic will resemble the plots given in Figure 1 (A and B).

The voltage sensitivity of non-linear dielectrics is a temperature-sensitive phenomenon. This can be either an advantage or disadvantage, depending upon the proposed application for the material. Figure 2 depicts the variation of dielectric constant with temperature, assuming a constant applied voltage. Note that the dielectric constant increases non-linearly with temperature up to a certain critical temperature known as the **Curie point**; and that beyond this point, K decreases as the temperature is increased further. The Curie point is at or near room

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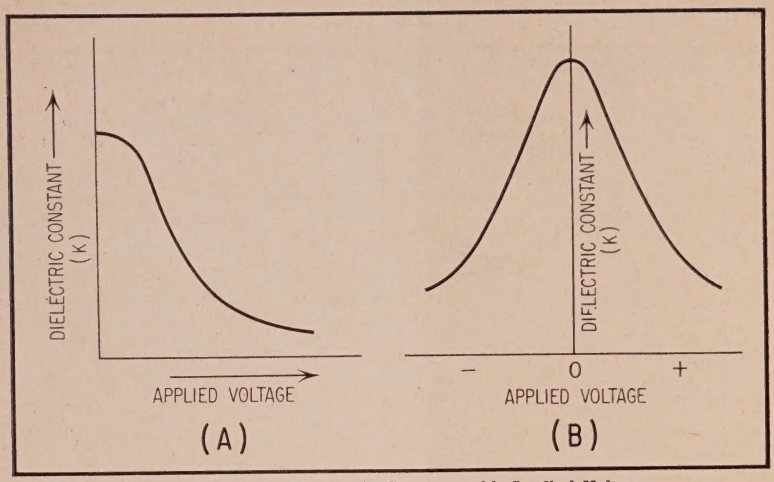


Fig. 1. Variation of Dielectric Constant with Applied Voltage.

temperature in some dielectrics, but many materials processed for ferroelectric applications provide Curie points at high temperatures well outside of the normal operating range.

Aside from the characteristics just discussed, ferroelectrics exhibit a hysteresis effect. This may be demonstrated with the setup shown in Figure 3. An a-c test voltage of desired frequency is applied to a ferroelectric plate (provided with flat parallel, plate-type electrodes) in series with a fixed capacitor, C. The capacitance of the latter is very high with respect to the capacitance of the ferroelectric. The internal sweep oscillator of the oscilloscope is switched off, so that the a-c source supplies a sine-wave sweep voltage. The voltage developed across capacitor C is proportional to the charge in the ferroelectric and is applied to the horizontal input. The pattern will resemble one of the shapes: Figure 4 (A, B, or C).

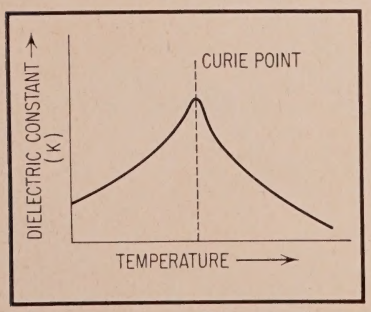


Fig. 2. Variation of Dielectric Constant with Temperature.

In Figure 4, the vertical axis represents charge in the ferroelectric, while the horizontal axis represents applied voltage. Response in all four quadrants is shown. The loops show the material to exhibit a saturation region at both positive (top) and negative (bottom) polarization, and rapid transition regions connecting the two.

When a ferroelectric possesses the severe square-loop hysteresis response

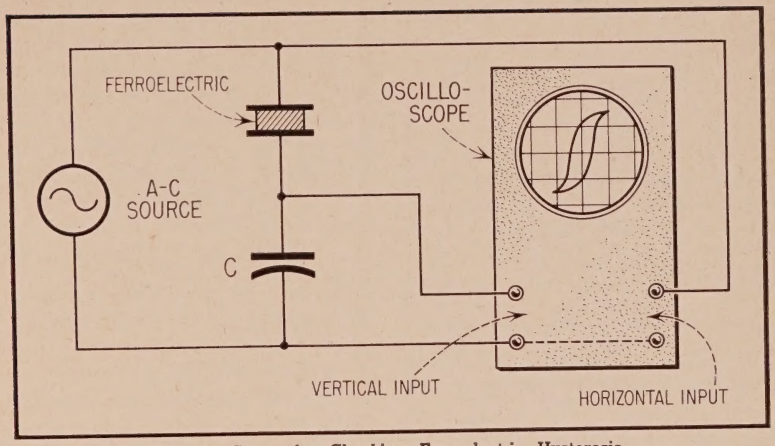


Fig. 3. Setup for Checking Ferroelectric Hysteresis.

depicted by Figure 4 (C), it has, in addition to other useful features, pronounced memory characteristics. That is, if it is polarized into one of its saturation regions by momentary application of a voltage of sufficient magnitude, it will remain so polarized indefinitely. If a voltage of the opposite polarity and correct magnitude subsequently is applied, the material will be polarized into the opposite saturation region where it will remain indefinitely. Thus, in Figure 4 (C), a positive voltage will flip the ferroelectric to 1, and a negative voltage to 2. Once the material has been saturated in the positive direction, further application of posi-

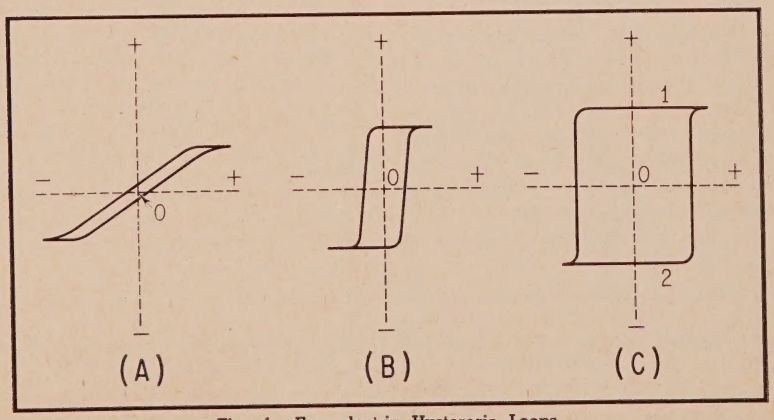


Fig. 4. Ferroelectric Hysteresis Loops.

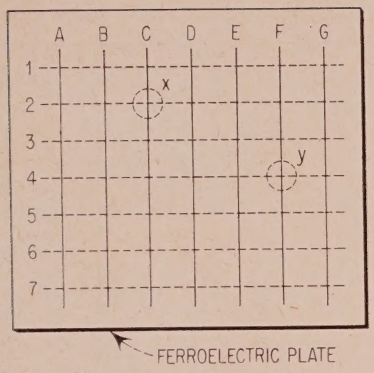


Fig. 5. Arrangement of Ferroelectric Memory.

tive pulses will have no effect. Similarly, when saturated in the negative direction, further negative pulses will have no effect. The effects discussed in this paragraph are possessed in lesser degree when the loops are not quite as square but more nearly resemble those shown in Figures 4 (B) and (A), in that order.

Electromagnetic Dual

The hysteresis loops given in Figure 4 are seen to resemble those of magnetic materials. The square loop (Figure 4C) is very desirable in magnetics, as it is in ferroelectrics. There are many applications of nonlinear magnetic effects which may be served also, to some extent at least, by similar ferroelectric circuits. In each instance, however, it is well to note that the two phenomena are duals. Thus, the non-linearity may be utilized for amplification, giving the magnetic amplifier in one case and the dielectric amplifier in the other. The duality in this example shows up in Table I below.

Ferroelectric Applications

In order to obtain uniformity of characteristics, single-crystal ferroelectric is employed in all exacting applications. Polycrystalline material is useful in many applications, however. Thin plates or slabs are cut or separated from the single crystals. These plates then are provided with flat, plate-type electrodes which are either fired or vacuum-evaporated on their flat, parallel faces. The result is a ferroelectric capacitor. Such capacitors are usable in amplifier, control, and flip-flop circuits having no tubes or transistors, and in special computer memory applications where a separate sub-subminiature ferroelectric capacitor is used for each memory cell.

In other applications; a large, single-crystal ferroelectric plate may be provided with a number of electrodes of suitable shape and size for the purpose of polarizing separately a number of tiny areas of the plate.

Computer Memory. An intriguing application which has attracted the interest of many workers with ferroelec-

TABLE I

Amplifier Type	Input Impedance	A-C Power Supply	Governing Reactance	Speed (Frequency Response)
Magnetic	Low	Low	Inductive	Slow (Low)
Dielectric	High	High	Capacitive	Fast (High)

tricity is the use of non-linear dielectric material as the basis of a simple, small-sized, static memory unit for digital computers. The basic principle of this device is illustrated by Figure 5. A thin plate of single-crystal, square-loop ferroelectric is employed. The electrodes consist of parallel metallic lines deposited by evaporation. One set of lines runs in one direction on top of the plate (as A, B, C, D, E, F, G in Figure 5) and the other set runs perpendicularly on the bottom of the plate (as 1, 2, 3, 4, 5, 6, 7). The point at which two perpendicular lines cross includes between them a small volume of the ferroelectric material. Thus, a tiny non-linear capacitor is set up at that point, as at **x** (the intersection of Lines 2 and C) in Figure 5. Forty-nine such intersections, and accordingly 49 capacitors, are shown in the Figure. The action of each capacitor is independent of its neighbors, although the dielectric is a single block.

Connections are made to external circuitry by attaching a lead to each of the metallic lines of the memory matrix or grid. Connections made to Lines 4 and F thus will utilize the capacitor formed at intersection y.

Memory action occurs in the following way. To "write" information into a particular memory cell (capacitor), pulses are applied simultaneously to the corresponding vertical and horizontal line-electrodes of the grid. For example, a pulse at 2 coincident with one at C will polarize the cell at the intersection of the lines at **x**. The dielectric at this point will be polarized to saturation and will remain in this state, thus "remembering" the pulse entry. Subsequent pulses of the same polarity can have no effect, since the cell now is filled. Information may be written digitally into the other cells in the same way.

To "read" information out of the memory, a cell must be examined (via the proper horizontal and vertical line-electrodes of the matrix) with coincident pulses of polarity opposite that employed in writing. If there is stored information, an output pulse will be obtained.

A distinct advantage seen for the ferroelectric memory is its large storage capability in small size. Many thousands of bits, for example, could be stored on a plate of 1 square inch size. Another advantage is the high impedance of this device, which makes it economical of power and renders it compatible with low-powered transistors which may be used as write-amplifiers. Disadvantages of the memory are the temperature-dependence of the ferroelectric material and the volatile nature of the memory action; i. e., the read-out is destructive of the information. A further disadvantage when barium titanate is employed as the ferroelectric, is the tendency of this material to fatigue in operation, becoming less effective as a memory material. Late work, especially at Bell Telephone Laboratories, show that GASH and triglycene sulphate exhibit little or no such fatigue.

Flip-Flop. Because of the bistable nature of the saturation characteristic of the ferroelectric, evident from Figure 4 and the attendant discussion, the ferroelectric capacitor in series with a suitable current limiting resistor will provide simple flip-flop action. The effectiveness is governed by the squareness of the hysteresis loop.

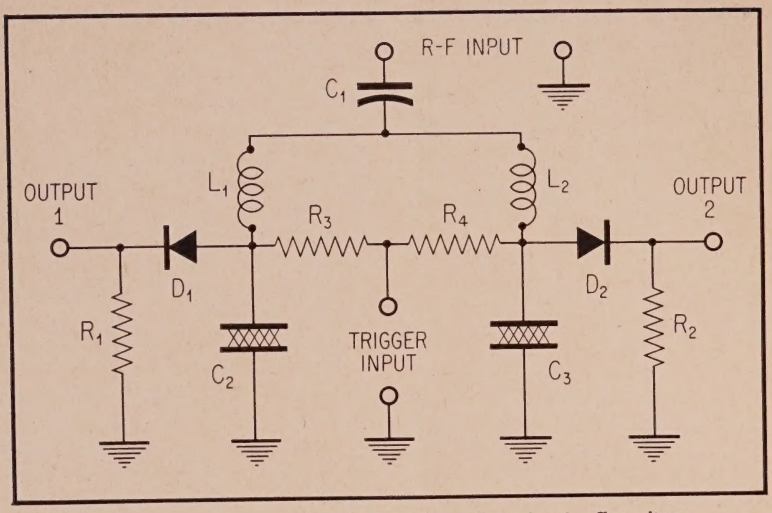


Fig. 6. Ferroresonant Circuit Employing Ferroelectric Capacitors.

A positive-going pulse of sufficient amplitude will polarize the capacitor (corresponding to binary 1 electrification). This state will be held. A subsequent negative-going pulse will depolarize the capacitor; or, if the pulse amplitude is sufficient, will polarize it in the opposite direction. This second stable state corresponds to binary O.

Flip-flop action may be utilized in the conventional manner to produce ring counters, shift registers, switches, and similar equipment.

Ferroresonant Circuit. The conventional ferroresonant circuit employs a non-linear inductor and conventional (linear) capacitor. This circuit has been applied to all well-known flip-flop uses, such as binary counters, ring counters, and shift registers. The functions may be shifted by employing a ferroelectric capacitor and conventional inductor, as shown in Figure 6.

Capacitor C_1 provides a common impedance for the two legs of the circuit. Its capacitance is very large with respect to that of the ferroelectric capacitors, C_2 and C_3. Conventional capacitors are in the latter position in the standard ferroresonant circuit. Linear inductors are employed at L_1 and L_2.

Upon application of a trigger pulse of suitable amplitude, the capacitance of C_2 is shifted sufficiently to switch the left leg of the circuit to its second stable state, and OUTPUT 1 is activated. Upon application of a subsequent pulse, the right leg is switched to its second stable state, OUTPUT 2 is activated, and the left leg is deactivated since both legs can not draw sufficient "firing" current simul-

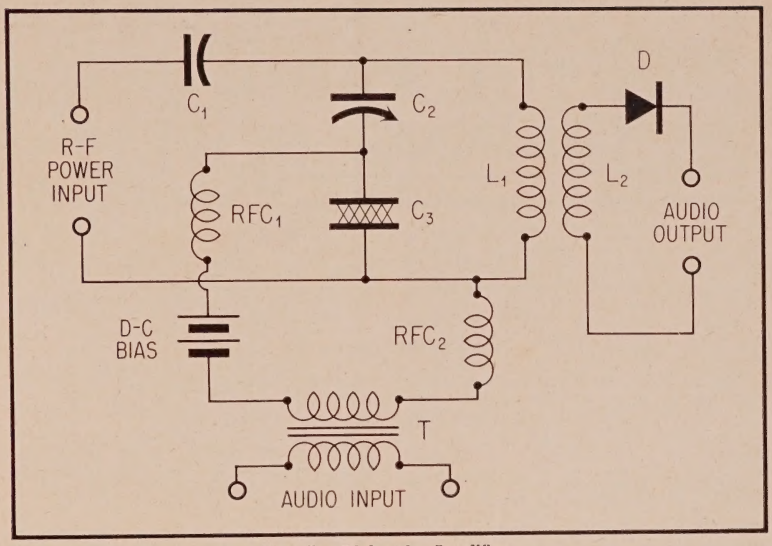


Fig. 7. Dielectric Amplifier.

taneously through the common impedance, C_1.

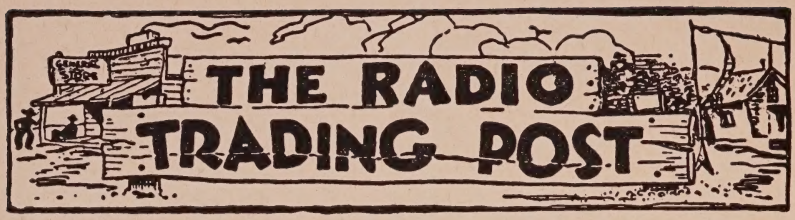
In all respects, this scale-of-2 circuit operates like the classic ferroresonant circuit except that the non-linear element in this instance is the capacitor rather than the inductor.

Dielectric Amplifier. Ferroelectric capacitors having hysteresis loops similar to that shown in Figure 4(A) provide useful amplification, both voltage and power, when operated in appropriate rf-powered circuits.

Figure 7 shows one type of dielectric amplifier for audio frequencies. The ferroelectric capacitor, C_3, is part of a radio-frequency tuned circuit. Inductor L_1 is tuned to the frequency of the r-f power supply by the conventional (linear) capacitor (C_2) and the ferroelectric capacitor (C_3) in series. Capacitor C_1 serves to block the d-c bias from short-circuit through L_1. The d-c bias sets the operating point along the non-linear curve (Figure 4A).

Input-signal a-f variations alternate the reactance of C_3, shifting the tuning of the L_1 tank above and below the operating point (carrier frequency of the r-f power supply). This produces an amplitude-modulated output wave. The audio envelope of this wave is recovered by the demodulator diode, D.

Considerable amplification is possible when the selectivity curve of the output tank circuit is steep and when the d-c bias is set for an operating point along the most linear portion of the curve. For a more detailed discussion of dielectric amplifiers, see C-D CAPACITOR, July 1954.



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SELL OR SWAP — 2 BC610's in good cond. — one for cash, swap 1 for Collins rcvr. BC610, fair cond., 813 final for cash. Make offer. Alan Finkel, 127 Greenbrook Rd., North Plainfield, N. J.

WANTED — Instruction manuals for sonobuoy AN/CRT-4 and AN/CRT-1B. Will pay high price. M. A. Colbert, 310 West 93 St., New York 25, N. Y.

WANTED — Used microvolt sig. gen. such as Measurements 80; used commercial two-way mobile units. Write details and price. James M. Babb, 1100 Warren, WaKeeney, Kan.

FOR SALE — Superior VOM 670-A super meter, never used, instruction book, $12. C. Stouth, Box 44, King of Prussia, Pa.

FOR SALE — Magazines: 34 Pop. Electronics $3; 76 Radio-TV News $7; 71 Radio Electronics $6.50, all for $15 FOB. Eino Hokkanen, 188 Crescent St., Athol, Mass.

TRADE — RCA 5819 photomultiplier tube and sodium iodide (T1 activated) scintillation xtal mounted, Harshaw model X6L2. Want mobile converter, xmitter, or test equip. M. Goodman, 2621 Burns Pl., Union, N. J.

WANTED — R.M.E. or other standard make of preselector for use in communications type rcvr. State particulars and lowest price acceptable. D. Lanesberg, 179 Marcy Ave, Brooklyn, 11, N. Y.

WANTED — April '57 issue of Popular Electronics. E. N. Christner, 313 Crawford St., Middletown, Ohio.

SELL OR SWAP — Gonset 3-30 shortwave converter, 3-30 mc, $20 plus shipping; RBM-4 rcvr. 200 kc-2mc, $45; ARC-5 80-40 meter rcvr. schematic and conversion data 50c; BC459 schematics, 25c. S. Consalvo, 4905 Roanne Dr., Washington 21, D. C.

WANTED — Heathkit AT 1 xmitter manual in good condition, $1.00. Robert Hoerter, 1035 Rahway Ave., Westfield, N. J.

FOR SALE — Globe Chief, 4 xtals, key, $43; 2-speed record cutter and playback unit minus cutting needle, electric eye type counter; 0-100 microameter Tripolet 3" meter, $5 each Morrow Gable, 31 Hazen St., Hilton, N. Y.

WANTED — Gonset converters and rcvrs., 6 v. and/or 110 v. for 30 to 50 MCs. Also xmitters and rcvrs. for 450 to 470 MCs. State price and cond. Leon J. Long, 2518 Propst St., Gastonia, N. C.

WANTED — 200 to 250 w. AM xmitter with power supply. Will consider good home brew job with good wiring. Prefer variable band xmitter. Cash or swap 75 to 100 w. outdoor amplifier and spkr. units complete. John Arnold, Wilson St. Bluffs 3, Ill.

FOR SALE — 375 w. xmitter Collins VFO-5763-2E26-813, $85. Prefer local. John Golembeski, 16 E 48 St., Bayonne, N. J.

SELL OR SWAP — Gonset 6-band converter, and practically new superceiver; Ward 10 meter whip and mount. Want good 50 w. phone, 65 w. CW xmitter. Alvin Dorfman, 100 Brookside Ave., New Haven, Conn.

FOR SALE — Hammond Solovox, $125; TV magnifying glass, makes 10 picture look 20, bargain, $10. Local only. Eugene Roy, 5 Hillside St., Haverhill, Mass.

FOR SALE — Simpson 383A "in circuit capacohmeter," l. n., $60. Gilbert Hamilton, Barnes City, Iowa.

FOR SALE — Precise 111 GM and Emission tube checker, perfect cond., $55. Paul Richter, 1448 Webster Ave, Bronx, N. Y.

TRADE — Full set of Gold clubs and bag; VOM battery opt; 4 x 5 press camera; sig. gen.; condenser checker. Want tape recorder. Emory Corron, 4096 Redonda Lane, Dayton 16, Ohio.

SELL OR SWAP — Popular Electronics Oct. 1954 to Feb. '58. All excellent cond. Want cash or model supplies. Local only. A. Jacobowitz, 2536 Cruger Ave., Bronx 67, N. Y.

SWAP — RCA 8PT7010 8" red portable TV and Rider TV20 for recent Hickok or other mutual conductance tube tester. Philadelphia vicinity only. H. Erfer, 1949 Park Blvd., Camden 3, N. J.

FOR SALE — Hickok 228X sig. gen., l. n., best offer. Yukio Motoike, 1918 W Roscoe St., Chicago 13, Ill.

TRADE — Eico 145 sig. tracer, l. n. What have you? Luke Strader, 1217 Myrtle Ave., Danville, Va.

WANTED — General Radio experimenter booklets, 1931 and prior issues; C-D Capacitor, vol. 1, 2, 3, 4; CR Jan. and May 1945 and QST Dec. 1915 and full 1916. R. E. Jones, 713 Front St., Catasauqua, Pa.

WANTED — E. H. Scott TV Service manual on Ravenswood model. State price. Wm. C. Leduc, 3 House Ave., Troy, N. Y.

WANTED — Vibroplex semi-automatic kev. Advise model and price. D. L. David, 214 S. Elwood, Tulsa 3, Okla.

FOR SALE — Perfect Sangamo N2T amperehour meter, 25 amp., 100 dial, $25; Fieler T-S2 sig. tracer analyzer, $15. P. F. Habek, 1162 Hayden Ave., Cleveland 10, Ohio.

WANT — S40B Hallicrafter rcvr. and Viking II in A1 cond. If modified state how. Must be bargain. David Messing, Gilead, Neb.

FOR SALE — Precision EV-10-S VTVM with HF probe, Sprague KT-1; Eico 425 scope; B & K 500 tube tester, all in top condition. S. Berger, 110-03-101 Ave., Richmond Hill 19, New York.

FOR SALE — Perfect BC-653-A with new tubes. Highest offer over $12. John Gershey, Lake Ariel, Pa.

FOR SALE — Riders Vols. 1-5 abridged, 4 to 16 inclusive, TV 1 and 2. No reasonable offer refused. George Greenberg, 821 Porter St., Philadelphia 48, Pa.

FOR SALE — RME speech clipper, $15; Electrovoice 3000 TV preamp, $10; James C1470 mobile, fixed power supply, $35; Tape Tone 2 mtr converter, $35; Telrex 2-mtr. beam, 5 elements, $5. K. Miller, 14979 La Cumbre Ave., Pacific Palisades, Calif.

WANTED — TV type rotator; print for RCA portable TV rcvr., model 14S7052, ser. B5083075. C. B. Kelley, 7204 Clovernook Ave., Cincinnati 31, Ohio.

FOR SALE — Comm. rcvrs. 234-258 mc, $1.95; chokes — Thord, 20C55, 15 hy @ 150 MA, $2.50; relay — latching DPDT, $1.00. All items perf. cond. Acme TV, 11 E. DeRenne Ave., Savannah, Ga.

WANTED FOR CASH OR TRADE — 500 w. multi match mod. output xformer or KW final complete. G. E. Howarth, 2161 Ave. East, Oskalossa, Iowa.

SELL OR SWAP — Unused BC-1335 xceiver 27-39 mc, GE citizens class A mobile rig, perfect, $50; Natl. SW3, $15. Need BC-348, BC-221, 1E-19, model 15 teletype, Command gear. E. V. Blaize, Jr., 2324 Mexico, New Orleans, La.

FOR SALE — Rider's Radio manuals 6 to 13, $50 plus C.O.D. Stephen Barniak, 2426 Perot, Philadelphia, Pa.

FOR SALE — Kansas-City Radio-TV course 101 lessons, including elements of FCC exam. 5 years old, $75. L. M. Baumgartner, 612 Barnes Ave., Endicott, N. Y.

WANTED — Portable baffle for 12" spkr. for cash or trade tube caddy or microscope. John J. Conroy, 2523 W. Willard St., Philadelphia 29, Pa.

FOR SALE — 1956 Chevrolet radio complete, $30; 1955 Plymouth radio (no speaker), $25. H. W. Lingenfelter, 21352 Kenwood Ave., Rocky River 16, Ohio.

WANTED — TV set instruction sheets with drawings from current RCA Institute or National School, Los Angeles. Must be in good cond. L. E. Salom, 724 Hunting Tower W, Alexandria, Va.

WANTED — Electrical appliance repairing course or books, color scope, transistor radio, 20 K multitester, Hallicrafter flyback 55H133-1 or Merit HVO-6. State price and cond. Hernandez Manuel, 148 South 8 St., Brooklyn 11, N. Y.

FOR SALE — NRI 45 multitester, probes and instructions, (less batteries) for cash, $24. Perfect operating cond. Thomas Engert, Jr., 1601 France Street, New Orleans 17, La.

WANTED — RCA Pict-O-Guide vol. 11. D. Sullivan, 2303 Clarendon Rd., Brooklyn 26, N. Y.

FOR SALE — Eico VTVM in working cond., $18 or trade for what have you? Hy Levine, Box 904, Liberty, N. Y.

SELL OR SWAP — Millen 90800, RCP VTVM, hv xformers, 4E27. Want UHF converters, ham gear. Oscar Hager, 102 Ravenna Ave., White Sands PG N. M.

FOR SALE — Precision E-200 sig. gen. Perfect cond., $40. Frederick R. Shutt, 612 Frantz Ave., Mullens, W. Va.

TRADE — Rider's "FM Transmission and Reception," l. n. Need 1% resistors for VTVM. William McKay, 198 Fairfield Ave., Kenmore 23, N. Y.

FOR SALE — VTVM with instrs, leads, $35, 260, $30; Precision 915 tube checker, $45; GE 250, $35; E-400 with xtals, $89.50; Super-Pro kit 110 LXR, $50; Simpson 269, $59. John Pellock, 715 N. 7th, Benld, Ill.

WANTED — Double pole double throw switch (power) to handle 120-240 A.C. voltage. Irv's Radio Service, 1409 24th St., Niagara Falls, N. Y.

WANTED — Inexpensive test equipment: VTVM, tube checker, scope, generators, etc. Kit type OK. Glenn Seaton, 14314 Ledgewood Ave., Cleveland 11, Ohio.

FOR SALE — Jackson filament xformer for 648 tube tester incl. selector switch, $5. Sunset Radio & TV, 1911 Coachman Rd., Clearwater, Fla.

JOB WANTED — As helper for TV serviceman. Attends RCA Institute at night, 6th term. Full or part time, salary secondary. James Harrigan, c-o McGann, 135 Pacific St., Brooklyn, N. Y.

WANTED — 1951 or '52 Midwest AM-FM-SW radio in good working condition, with or without console. Must be cheap. J. F. Caldwell, 1300 Twyman St., Marshall, Texas.

FOR SALE — 16" steel recording turntable, 72#, 1½" shaft on ball and hardened plate, finished in copper hammertone. Best offer over $35 plus shipping. Raphael Ehat, 57 Sussex St., San Francisco 12, Calif.

TRADE — Supreme Publications vol. 9 Television 1955 for vols. 2, 3, 6, 7, or 8 of TV series. My copy l. n. Would buy other copies if for sale reasonable. John S. Dewey, Box 252, Osceola, Mo.

FOR SALE — Zenith port. trans-oceanic; 45" telescope; Webster recorder. C. Harris, 112 Wellington Hill, Boston 26, Mass.

WANTED — Tubes, schematic and any information for U. S. Apex 110 v. radio. Leo Teply, Geddes, So. Dak.

WANT — Jackson TVG-2 sig. gen., Wallaces Teledides, Supreme TV publications. Will purchase or trade: fast check tube tester, NRI tube tester with Pix adapter, Superior pix tube tester, Precision 68 or Heath V-7A VTVM's. All practically new. AC/TV Distributors, 700 W. 65th, Seattle 7, Wash.

FOR SALE — Rider's TV manuals 1 thru 10, perfect cond., $75. George Krauss, 44 Valley Stream St. at Greenlawn Ave., Islip Ter., L. I., N. Y.

FOR SALE — Little used NRI 34 professional sig. tracer, $40; Heathkit TV alignment gen., oscillator, and TS-2 marker, $42; TV crossbar gen., $20. Michael Chippa, 7267 Kingsbury, Dearborn, Mich.

WANTED — Hallicrafter 1948 T54 mt'l cab. push button TV, clean appearance but need not work. State lowest price or possible trade. F. Nordlander, 520 23 St., Union City, N. J.

WANTED — Tape recorder, Revere push-button type or Teltape battery type. Eugene Kon, 1516 Broadway, Buffalo 12, N. Y.

WANTED — Transformers mfd. by United Transformer Co. (UTC). State model number and price. R. Spera, 37-10 33 St., Long Island City, N. Y.

SELL OR TRADE — L. n. cond. all detection DS 277 scintillator and inst. book. Supreme AF100 xmitter 4-65A final 200 w. and inst. book. Cash or need good ham band rcvr., complete mobile rig 75-10. Donald M. Burrill, Burrill Ranch, R. F. D., Washington, Maine.

SELL OR TRADE — L. n. 15 meter 2-element beam, DX-20, $29; Heath Q-multiplier, $5; two-meter converter and 414-A two-meter modulator. Want vertical antenna (Mosley, etc.). M. L. Braun, 202 Howard St., Bellevue, Ohio.

WANTED — Hickok 770 oscilloscope, RCA Pict-O-Guide vol. 1. Paul Capito, 637 W. 21 St., Erie, Pa.

WANTED — Schematic wiring diagram for 1954 Sentinel 15" color TV, serial 151. Jim Zarembski, 5512 N. Montclare, Chicago, Ill.

FOR SALE — 1929 Temple TRF 8-61 console, excellent cond., original instruction and log books, $10 plus shipping or pick it up. Will trade for in-set condenser checker. A. B. Klyne, 217 W. 16 St., Dover, Ohio.

FOR SALE — Used — everything in radio from resistors to TV rcvrs. Tell me what you want. Sam Lipson, 1 Kensington Heights, Worcester 2, Mass.

WANTED — HRO-5 B & C bandspread coils, RME 10-20 converter. R. B. Baxter, 118 Luzena Ave., Vacaville, Calif.

FOR SALE — Mallory vibropak, good cond., input 6.3, output 300 v. DC @ 100 ma.; synchronous vibrator, no rectifier tube needed. $5 plus postage. H. Van Dick, Riverlawn Dr., Wayne, N. J.

WANTED TO BUY — High voltage power supply, 1250 v, 300 ma., or components to build same: also 125 w. modulation transformer. Robert Camp, 1042 Water St., Moosic 7, Pa.

WANTED — TV tubes — 3BC5, 5AT8, 3CB6, 5AM8, 6BH8, 5V8, 6BN8, 5AQ5, 6CM7, 6CG7, 12AV5/GA, 12AX4/GTA, 1B3/GT. Trade other radio and TV tubes for tubes. Charles J. Needham, Maple Ave., Box 87, Hebron 3, Ohio.

SWAP — Dumont 3" scope; Jackson 640 sig. gen.; Electronics Designs VTVM, $100; Triplett 2413 tube tester; for 1949 or 1950 car in running condition. D. McCarthy, 32 Chatham St., Hartford, Conn.

FOR SALE — Philco Jr. 7019 scope, 2" tube, $20; Eico 320 AM, 150 kc to 102 mc sig. gen., $10; instruction books ,incl. P.P. C.O.D. only. Is Wolf, 526 W. 113th St., New York 25, N. Y.

TRADE — GE 220 v. Mercury switch, 2 telephone lever switches 4PDT, 2 Standard coil TV tuners with tubes, NRI 33 sig. tracer l. n., 2 AN-130-B mobile whip. Want 2-speed 2-track tape mechanism in new cond. The Toll House, Box 46, West Cornwall, Conn.

JOB WANTED — By graduate, Radio-TV Service school in TV repair shop. Part time, Sat. only, vicinity Bronx. Salary unimportant. George Gorman, 787 Crotona Pk. No., Bronx 60, N. Y.

FOR SALE — Rider's Radio manuals 11, 12, and 16, $8. Postpaid. Al's TV, 11 Willow St., Bayonne, N. J.

WANTED — Motorola test set for servicing two way radios. M. S. Breyfogle, 22 N. 7 St., Estherville, Iowa.

TRADE — Knight ocean hopper, 6 coils and cabinet, 155 Kc to 30 Mc; Zenith trans-oceanic H-500, both l. n. Want radio control equipment for models. David DeCobert, 609 Henrietta St., Gillespie, Ill.

WANTED — Ampex portable tape recorder; Western Electric 9-A transcription arm with LP cartridge adapter; Altec spkrs. with or without baffles, AM-FM tuner with amplifier; plus other Stereo components. V. Mayher, 168 Williams Ave., Hasbrouck Hts., N. J.

SELL OR TRADE — Hickok 900A multirange volt, amp, and wattmeter; Jackson 523 scope; CRT adapter for Precision tube testers; ¼ hp motor with water pump. Want clamp-on ammeter, lab. DC or AC volt, amp, wattmeters. David Levine, 1783 Fulton Ave., Bronx 57, N. Y.

FOR SALE — Heath: 0-10 scope, $50, TS-4 sweep-marker gen. incl. xtal, $45; Sprague TO-4 Tel-O-Mike, $55; Precision E200C RF marker gen., $50; Webcor 2611 tape recorder, $110. Local. G. Dalamango, 160-26 26 Ave., Flushing 58, N. Y.

FOR SALE — Knight space spanner, $8, needs repair; 2 DC voltmeters, $1 each; 1 DC ampmeter, $1.75. John Westergaard, Jr., R. 2, Pound Ridge, N. Y.

FOR SALE — Super-Pro power supply, RA-84-A, never used. Make offer. R. Balbert, 16119 W. Hart St., Van Nuys, Calif.

FOR SALE — GE Faximile recorder amplifier, RA-3, approximately 20 lbs., lots of parts, $6, shipping extra. Details on request. John A. Fels, 801 Silver Spring Ave., Silver Spring, Md.

FOR SALE — Heathkit TC-2P tube tester with pix tube short remover, 1958 tube chart, $25; Heath Linearity Patton gen. LP-1 converted to LP-2, $11; NRI electronic multitester with AC head attachment; $10. All A-1 with instructions, F.O.B. W. J. Wengler, 311 Preston Ave., San Antonio 3, Texas.

WANTED — AM-FM rcvr., communications rcvr., and xmitter. Have novice HT17 xmitter, complete; National RC-105 (Navy HRO) rcvr.; Simpson 260 multimeter. Martin Schiff, 12 Burbank St., Yonkers, N. Y.

SWAP — Complete course on Radio-TV Electronics by National School of Calif., without kits, for 16mm sound projector and 16mm sound film. J. Rempler, Whitehouse, N. J.

FOR SALE — C-D converter, 110RT35 110 VDC to 110 VAC 500 w. intermittent, 350 w. continuous with automatic turn on for TV set operation; Hallicrafter T54 7" TV, 19" relay rack mounting with cabinet. Each $35 FOB. Stephen E. Lipsky, 64-85 Wetherole St., Forest Hills, Queens, N. Y.

FOR SALE — 274 Dumont scope; 911 McMurdo-Silver sweep gen.; 777 Weston tube tester; BC 605 D interphone amp, 458A 5.3 7 mc and 696A 3-4 mc. All good condition, reasonable. H. K. Elwood, 20 Catalpa St., R 1, Jeffersonville, Ind.

FOR SALE — Mopar 800 radio, and 7" Motorola TV, $15 each; 10" Admiral console and 10" Emerson table model, $20 each; Philco 78 rpm record changer, $5. All in excellent cond. Harry's TV, 120-51 232 St., Cambria Heights 11, L. I., N. Y.

FOR SALE — Two 0-1 MA meters l. n., 4½" bakelite case, knife-edge pointer, VOM scale, 50 ohms internal resistance. Ship $5 each postpaid. L. Wienreb, 151-09-34th Ave., Flushing 54, N. Y.

WANT — Rider's Radio vol. 3, 9, 10, 13, 15 up; TV vols. 10 up; Sams sets in envelopes. Buy or trade Rider's radio vols. 7 and 8; Sams in 2 binders containing sets 1 to 9 and 50 to 59 plus 91 and 91A. John Jackson, 71 Regent St., Wilkes-Barre, Pa.

FOR SALE — 21 early issue High Fidelity magazine, vols. 1 to 5; 46 issues QST's 1940 to 1944 including 25th Anniversary issue. Send half your offer — will parcel post for balance plus postage. Harold MacDonald, Box 593, Kodiak, Alaska.

BUSINESS FOR SALE — TV Service business, est. 10 years, complete equipment and stock. Modern 3-bedroom home separate on same property, $9,500. Bernard M. Rice, 817 7th St., Three Rivers, Mich.

FREE COURSES in radio and TV service. William E. Grady Evening Trade School, Brighton 4th Road and Banner Ave., Brooklyn, N. Y. Registration at school Sept. 8, 9, 1958, 7 to 9 P.M.

WANTED — Electric or hand-operated adding machine. Cash or will trade tube tester or pix tube rejuvenator. William S. Grossman, 6324 N. Troy St., Chicago 45, Ill.

FOR SALE — GE UHF 101 translator, mahogany case, with glass dial, $20; Sutco booster and UHF converter, model 21A, metal case, $15. Harold Reider, 1017 N. 11th St., Reading, Pa.

FOR SALE — Simpson 260 in roll top case, l. n., with leads and manual, $30. James P. Torre, 101-48-120 St., Richmond Hill 19, N. Y.

SELL OR SWAP — ARC-4 xmitter with tubes, $15; DM-42, $10; mobile xmitter 30 to 42 mcs, 6 v., $10; VC-16 vacuum tubes, $5; large ant. rotary coil, $10; BC-906 freq. mtr., $15. Want 3-speed record changer. Thomas Koscica, 226 Eastern Pkwy., Irvington 11, N. J.

FOR SALE — Rek-O-Kut T-43-H 12" turntable with hysteresis motor, $35; R-J F-15-M mahogany cabinet for 15" spkr., $20; U.T.C. LS-21 and LS-25 transformers, $2 each F.O.B. Jack Atkins, 1375 27th St., Ogden, Utah.

TRADE OR SELL — RCA broadcast lapel mic, needs ribbon; BT DA2-1-M distrib. amp; Webster 156 changer; Pickering S-120M cartridge; 5820 image orth. J. A. Rosse, 523 Harrison Ave., Scranton, Pa.

SELL OR TRADE — Acousticon A-152 hearing aid with tubes; Weller WD-250, ¼", 1.9 amp. hand drill with Jacobs chuck and 40 drills in index; Mantola 11-701 AM-FM radio. Peter C. Robie, 559 Pleasant St., S. Weymouth 90, Mass.

WANTED — In line tape head to fit VM 700 tape recorder (to convert from staggered to inline — stacked stereo) to replace 817 Shure head. Jerry Robinson, Radio Electric Service, Wilbur, Wash.

SELL OR TRADE — Complete Export-Import course l. n., for test equipment or best offer. Selcraft, Box 394, Spring Valley, N. Y.

WANTED — ATR or other name brand inverter, 12 volt, 150-175 watts; good used tube tester. Henry L. Marple, Box 168, Buckhannon, W. Va.

FOR SALE — Complete radio station: S40A rcvr., WRL 755 VFO, Globe Chief 90 xmitter, SM-90. Factory assembled except SM-90, $150; Solar CF-1 cap. analyzer, $25; Supreme 401 sig. gen., $20. Excellent cond. Ora J. Ballard, Center, Neb.

FOR SALE — QST 1942-1957, $32; IRE 1945-1957, $65; Radio News, 1944-1957, $28. All first-class cond. and complete, FOB Boonton. Harry Bremer, 43 Washington Ave., Lake Hiawatha, N. J.

WANTED — TV sets in working condition: RCA 630TS; Stromberg-Carlson TV-12; Hallicrafter T54 or 505. F. Santiago, 769 Bryant Ave., Bronx 59, N. Y.

WANTED — 6 or 6-12 volt vibrator power supply with 300 v. at 125 ma. output. Michael Vassallo, 99 Greenpoint Ave., Brooklyn 22, N. Y.

FOR SALE — Sams in good cond., 50c each, plus $1 towards parcel post: 16 to 24, 48, 70, 78, 81, 100, 110, 113 to 115, 118, 128, 131, 163. Inlet Elect. Service, Hiway 17 and Beaty St., Murrells Inlet, S. C.

FOR SALE — Home-made 12 w. CW xmitter; Terman's Radio Engineering, '32; Cooke's Math for Electricians and Radiomen, '42; Lauer and Brown's Radio Engineering Principles, '28. Make offer. Diamond, 130 Walnut, Paterson 2, N. J.

FOR SALE — Rider's Radio Trouble-Shooters manuals 7 through 22, $100 plus freight. J. S. Forbregd, 780th AC&W Sqd., Fortuna AFS, Westby, Mont.

FOR SALE — Heath Q-Multiplier, $7; Eico 352 bar gen., $10; Terado inverter 6 DC to 110 AC 60 w., $8; old band FM tuner, needs work, $8. Plus postage. Dick Rogers, 28 Bellamy St., Boston 35, Mass.

SELL OR SWAP — 80m and 40m VFO, $7.50; code practice oscillator, $2.50; Weaver B4 10X scope, $7.50; 300 w. CW-AM xmitter needs slight repairs, $65. Crowley, R. 1, Box 62, Oakridge, N. J.

SELL OR TRADE — Philco UT21, UHF tuner, all channel. Sell or trade for good camera. Walter Huey, Jr., 118 East Franklin St., Monroe, N. C.

SELL OR SWAP — Tubes 4-125A, 832A, 813, 4-1000A, 4x150A, 4-65A, 4C35, 3E29, 807; chokes, 450 mills, 16 henries, filter condensers hi-volt., hi. cap. Want good tape recorder. Rosellini, 2619 So. Gaylord, Denver 10, Colo.

FOR SALE — 630 chassis for 21" tube. Mask, safety glass and all brackets, Dumont 21EP4B. W. A. Toepel, 70 Washington Ave., West Caldwell, N. J.

FOR SALE — Two unused PE 101-C converters for 6 or 12 volts, original cases. Ham conversion information supplied, $6 each. William H. Greenbaum, 17 Poplar St., Elmsford, N. Y.

FOR SALE — Hard to get tubes and ballast resistors for old or antique radios. Also obsolete vibrators from '31 on up. Vance Lind Radio and TV Service, St, Paul, Neb.

FOR SALE — 10 meter mobile rig: l. n. Mallard 10m converter, converted link xmitter 10 w., all cables, controls, mic and whip ant. with mount, for 6v operation. $75 takes all. Local only. V. E. Freist, 27 Towers La., Staten Island 14, N. Y.

WANTED — Measurements Corp. Standard 65B sig. gen.; Gonset 66B rcvr., and 77B xmitter for 12 v. operation; Leece-Neville 12 v. gen. Must be reasonable. L. J. Schnedorf, 610 Monroe Ave., River Forest, Ill.

WANTED — KW final amplifier and modulator in enclosed relay rack with power supplies. No junk. D. Phillips, 49 E. Grandview Ave., Sellersville, Pa.

SELL OR TRADE — Electronic Decision Meter as in Oct. 1955 Popular Electronics. Sloping panel cabinet, black wrinkle finish, 2½ meter. Make offer or trade for? T. A. McDonald, 2680 Tremainsville Rd., Toledo 13, Ohio.

FOR SALE — Perfect Simpson Capacohmeter 383-A, $70. R. C. Hequet, 795 N. 10th, Kankakee, Ill.

FOR SALE — Going out of business, all items dirt cheap: Heath VOM, $7; Magnavox FM tuner, $10; UTC S-45, $6; Stancor P-3060, $2; Ram Y70F14/43, l. n., $4, etc. Frank Morretta, 4202 Richmond Ave., Staten Island 12, N. Y.

TRADE — 2 good unused Meissner 80 FM tuners less tubes, for good 6-12 v. batt. eliminator. Joe Billingsley's Radio Service, Hardy, Ark.

FOR SALE — Two Meissner 150-B xmitters. Will swap the one in vertical rack modified for 15 mtrs. Other one with xtal controlled driver for novice, $150 apiece, no shipping. R. J. Carpenter, 18A North Park St., Cambridge, N. Y.

FOR SALE — Complete Hi-Fi: Weathers Debonnaire with diamond stylus, Heath W-3AM 20 w. amplifier, University MID-T tweeter, 12" WE 728B buffer in enclosure, ready to play, $150. A. Marchegiano, 1734 Johnston St., Philadelphia, Pa.

FOR SALE — Navy transceiver MAR 225 to 390 mc., good cond.; dynamotor 12 VDC 3 amp 235 VDC .075 amp, l. n.; DC motor 1/16 hp 27 VDC 9.5 amp. Best offer. L. H. Carver, 2759 Rainbow Road, Jacksonville 7, Fla.

FOR SALE — Precision EV-10 VTVM, perfect cond., $75. Complete 18-watt sound system free with the above. John W. White, 207 W. Cleveland, Greenwood, Miss.

WANTED — Transistor checker; small AC-DC radios. State condition, description, and price. Kenneth Miller, 10027 Calvin St., Pittsburgh 35, Pa.

FOR SALE — 7JP4 and 8BP4, 10" GE TV; Hallicrafters S-38-C; Revere F100 tape recorder; 16mm projector. Cash or trade for Regency ATC-1 transistorized converter. Eugene Thompson, 308 West 4 St., Aledo, Ill.

WANTED — RCA type WO-57A or 57B oscilloscope. J. E. Smith, 3221 Willow Ave., Brunswick, Ga.

WANTED — Sprague TO-4 tel-ohmike must be low price, in repairable condition. J. Kozma, 12450 NW 5 Ave., Miami 50, Fla.

FOR SALE — Complete Sams Foto-Facts, 1-130 in binders and 131-180 loose. Make reasonable offer. Delivered within 50 miles or shipped collect. Robert D. Vosbury, c-o South Side Electronics, 257 Flora Ave., Johnson City, N. Y.

SWAP — Harvey-Wells 50D; Hallicrafter 40A rcvr.; 5-element beam for Gonset communicator. George Arnold, Roxana, Ill.

WANTED — Gonset 3128 push-button converter; Hallicrafters R-46B speaker. Barry Moore, R 1, Bangor, Pa.

FOR SALE — Frequency meter, BC-221-D, regulated power supply, original calibration book, $80 cash, FOB. K. B. Long, 608 Mary St., Utica 3, N. Y.

WANTED — Service manual or complete alignment information for Army Signal Corps walky-talky BC-611 chassis. Mervin E. Nielsen, Ringsted, Iowa.

SELL OR TRADE — Color-Tel color converter. Cash or tape recorder. Golden's Radio & TV, 200 Toler St., Malvern, Ark.

FOR SALE — Perfect NRI multi-tester AC powered with AC-RF head. Best offer. John Strazza, 48 Pulaski St., Bloomfield, N. J.

WANTED — NRI or similar appliance repair course. Carl Magrie, 633 Lillibridge, Detroit 14, Mich.

FOR SALE — Radio and TV sets and test equipment. Send for list. John Handzo, Jr., 211 So. Broad St., Elizabeth, N. J.

WANTED — FBX-7 rcvr. with coils, also coils for FB-7. R. Grigas, 7518 Merrill Ave., Chicago, Ill.

WANTED — Hi-Fi equipment: 3-speed record player, amplifiers, speakers, and cabinets. Maurice C. Superville, 4614 Huisache St., Bellaire, Texas.

FOR SALE — Heath EA2 12w bookshelf hi-fi amplifier, with cabinet, perfect cond., less than kit cost. Amp. kits expertly wired. A. Halasz, 59 Alfred Terr., Randolph, Mass.

SELL OR TRADE — Zenith Royal hearing aid for radio and TV test equipment. Richard Garcia, 119 E. Main, Anadarko, Okla.

FOR SALE — Rare E.I.Co loose coupler 1910; other very old items. Charlies Radio Service, 81 Warren St., Roxbury 19, Mass.

TRADE OR SELL — Collaro 4-speed record changer in original carton; clean Web-Cor tape recorder; Voightlander Bessa II camera with case, 1. n. Best cash offer or trade. Walter Bartell, 5536 Wilton Ave., Chicago 30, Ill.

FOR SALE — Hallicrafter SX-71 rcvr., $150, exc. cond. Prefer local. R. Gould, 2144 Manzanita, Menlo Park, Calif.

SELL OR TRADE — BC-412's; Signal Corp scopes; Radar and Sonar gear; xformers, CRT's; Admiral and Hallicrafters 7" TV's, parts of all types. Want hi-fi, test gear, etc. Hugh G. Stacy, 10 Hudson St., Natick, Mass.

WANTED — Any model Ampex tape machines, accessories for cash or trade hi-fi tuners, amplifiers, speakers. S. A. Cisler, 424 Bucknell Rd., San Mateo, Calif.

FOR SALE — Like new Marine radio rcvr. AR 8503 RCA 15 to 600 kc; radio xmitter and rcvr. BC-654-A. W. T. Bouchery, 188-14 87 Dr., Hollis, L. I., N. Y.

FOR SALE — Rider's radio manuals 1 to 5, 7, 9, 10, 12 to 15, $7.50 each or $56 for all plus delivery. Ferone Radio, 2123 W. 51th St., Chicago 9, Ill.

FOR SALE — Heathkit electronic crossover, $18.95; Marantz electric crossover in cabinet, $77; Dynakit Mark II amplifier assembled, $75, unassembled, $60; Dynakit preamplifier, unassembled, $30: F. W. Marble, 5165 Harper Rd., Solon, Ohio.

FOR SALE — Maica hearing aid; 832A; 3E29 and 2X2A tubes, for cash or 6 meter Halo or beam grid dip osc., condenser checker, or Match Box. E. W. Barth, 333 Washington St., Chelsea, Mich.

BUY, BORROW OR RENT — Schematic or photostat of Clough-Brengle model OCA signal generator. C. K. Kretchmer, 2009 E. 30 St., Baltimore 18, Md.

WANTED — AC gen., program time clock, adding machine, 152-172 rcvr., tape recorder, movie projector, marine radiophone, 6 v. to 110 AC 100W inverter. Cash waiting. S. Krzak, 65 Main., Pawtuxet, R. I.

FOR SALE — Eico VTVM; NRI Radio-TV course; small GE TV set, radio units, parts, books, magazines, Practical Math, machinists tools, etc. G. R. Parshall, Rt. 25, Niagara Falls, N. Y.

SWAP OR SELL — VTVM, VM solar radio diodes, meters, ARB rec, 3-speed phono. Thomas Rohland, R 3, Martinsville, Ind.

FOR SALE — Eico 377 square wave gen, $20; Central Electronics Q multiplier, $12; Bogen amplifier PV10, $20. Jos Barry, 105-08 133 St., Richmond Hill, Queens, N. Y.

FOR SALE — FM TV astatic booster, $10; Hastings FM car radio, $60; Espey AM-FM radio, exc. cond., best offer over $40. Irv Goodman, Condon, Ore.

SELL OR TRADE — CFN-46 AGW converter, R-89/ARN5A rcvr., BC-453 rcvr., converted to 110 v., T-23 ARC5 and BC-4Q-430 trans, BC455 converted to 10 meters 110 v. Misc. tubes and parts. Need test equipment. Glenn Troxel, R 2, Morris, Ill.

FOR SALE — Precise 116 w tube tester in exc. cond., $72.95. Gerald Davis, R 1, Alum Bank, Pa.

FOR SALE — DX-100, $200; SX-43 rcvr. with R42 speaker, $110; Viking Adventurer, $40, all good cond. Local. Bob Gellert, 61-41 157 St., Flushing 67, N. Y.

FOR SALE — Globe King 275 with built-in VFO and de-TVI'd; RME 45 rcvr. with HF 10-20 converter and Central Electronics Q multi.; Browning MJ-9 freq. meter and other equipment, reasonable. E. E. Miles, 350 W. Main St., Kutztown, Pa.

FOR SALE — Local only — cash. Heathkit BC-1A AM tuner, variable selectivity, $17.50; 12" Conrad viscous damped tone arm with extra damping fluid, $7.50. Both slightly used. Bill Honer, Jr., 1594 Dougles, Trenton, Mich.

WANTED — Operating instructions for model 60 Earl Webber Co., tube tester. Need not be orig. Ed Hietala, R. 1, Staples, Minn.

FOR SALE — Heathkit AR-3 communications type rcvr. with QF-1 multiplier in original cabinets, built in speaker, factory aligned and tested, exc. cond. Best cash offer. D. Landesberg, c-o YMCA, 179 Marcy Ave., Brooklyn 11, N. Y.

SELL OR TRADE — Perfect SX-104, 30-50 mc FM, one crystal controlled frequency, $60 prepaid. Al Werhan, Manlius, N. Y.

WANT — Hickok PR 203 or 209A. Dick Sebul, 9991 Albion Rd., North Royalton 33, Ohio.

FOR SALE — BC221AH freq. meter, 125 to 20,000 kc, $50; Precision 910 dynamic electronometer tube tester, $15. Ed Larabel, 344 Dickinson SW, Grand Rapids 7, Mich.

TRADE — For Photofacts: Retina IIA camera and accessories, approximately $250 original value. Lovette's TV, 174 E. Main St., Bradford, Pa.

FOR SALE — British Royal Monarch Intermix record changer with base, 45 rpm adapter, Ronette 284P cartridge plus manual, 1. n., $27.50; BC-929A military surplus scope, converted to 117 VAC operation, $20; push-pull hi-fi amplfier, $21. Victor Wong, 430 Southview Ave., Cincinnati 19, Ohio.

FOR SALE — Jerrold TV distr. amplifier, $35; Link crystal controlled 152-162 mc rcvr. with squelch operated relay-rack mount, $25; 120 w. 10 meter xmitter PR807's modulated, $30; 12 v. dynamotor output 425 v. at 375 ma. assembled on Johnson base kit, filter and relay, $25. Robert Schmauss, 3903 Swann Ave., Tampa 9, Fla.

WANTED — Books only of General Electronics, Industrial Electronics, Automation, or Computer courses. Include price and description in first letter. John Hicks, 1136 Margray, Pittsburgh 7, Pa.

FOR SALE — RCA WV97A voltomyst complete with leads, slightly used, but perfect working order. Best price over $48. Vincent Vigliano, 70-80 Kenmore St., New York 12, N. Y.

WANTED — Instruction book for operation of General model 200 sig. gen. W. L. George, 221 Palmyra Dr., Orlando, Fla.

FOR SALE — Surplus BC-474A transceiver in perfect cond., with War Department instruction manual. Freq. range 3,500 — 6,300 kc. N. Y. state only. Eric McLoughlin, Box 426, Mamaroneck, N. Y.

SWAP — TO-280 Acrosound output trans.; unused set of coils for Hallicrafters S38B; perfect Mossberg 20-power spotscope, for communications rcvr. or what have you? Thomas Loftus, 141-10 28th Ave., Flushing 54, N. Y.

FOR SALE — 433 Precision meter; 0-15--300-500. 0-15-150, 1-150-300 VAC; 0-15-30, 0-150-300 ACma; 0-1-2. 5-5, 0-10 ACA. $65 each FOB. Emil Backstrom, 5235 North Winthrop Ave., Chicago 40, Ill.

FOR SALE — Eico 315K sig. gen., $26; model 324, $22. Both wired and calibrated. D. Pollock, 178 Pinckney Rd., Little Silver, N. J.

WANTED — 12 v. converter for car; VU meters; 12 v. car radio with short wave; electronic organ kits. Hy White, 1105 Waller Ave., Winnipeg 9, Canada.

WANTED — Table model AM-FM radios. State make, model and best price. Mercury Radio, 433 South Wabash, Chicago 5, Ill.

WANTED — Riders TV manuals 8-14. State lowest price. Modern Electric, 111 Main St., Waterville, N. Y.

FOR SALE — Gonset II deluxe 6 v.; National HRO 50D; Bromeco 10m mobile trans. Best offer. W. Ribol, 125 Roff St., Stapleton, S. I., N. Y.

FOR SALE — Tubes, 70% off of list. Many popular kinds and types. Write for prices for lots of 100. Fred Gustke, R. 7, Box 14, Crown Point, Ind.

SELL OR TRADE — Cabinet and used pix tube for RCA 640 type rcvr.; GI 2DG4, phono motor; GE ST2C scope. J. Risse, 523 Harrison Ave., Scranton, Pa.

FOR SALE — Inductuner for channels 2-13, with 2 unused 6J6 and a 6AK5, $5. E. P. Sadler, 398 Sigourney St., Hartford, Conn.

SELL OR SWAP — The only SCR 59 U. S. Signal Corps aircraft radio receiving set in the world, VT-1 tubes, made and patented by West. Elec. in 1905. Make offer. Joseph T. Beck, 3330 S. MacDill, Tampa 9. Fla.

TRADE — Radio and TV Institute, New York City, technical course in electronics, radio and TV, including lab. instructions, complete. Hollis-Electronics, 87-10 204th St., Hollis 23, N. Y.

SELL OR TRADE — Two Vocaline 465mc with license application, warranty and ground plane antennas, for 25% off net list or mutual conductance tube tester or Riders TV manuals. Vick Radio Service, Kershaw, S. C.

SELL OR SWAP — Police-alarm FM 152-172 mc. 1. n., $30. W. T. Souder, 7th and Pine Sts., Millville, N. J.

FOR SALE — Stock of tubes, list $1485; Precision E-200C sig. gen.; Sparx 905 sig. tracer; Riders manuals 1 to 22. Earl Sloan, Lakeview, Ohio.

TRADE — American photocopy machine with accessories for new radio-TV tubes, test equipment, record players, or what have you? Will do first-class printing for these items. E. G. Bartlett, Atlanta, Mo.

SELL OR TRADE — Two TV sig. boosters, $7 each; phono preamp. for GE reluctance pickup, $5 plus postage. Or what have you? L. W. Reinhart, 1927 Madison Ave., Cincinnati 31, Ohio.

FOR SALE — 2 UV201 RCA Radiotron: 2 UX226 RCA Radiotron; CX112-A Cunningham; QRS Redtop rectifier; RCA Radiola power supply with UX-280 RCA rectifier. Make offer. Terry McDonald, 2682 Tremainsville, Toledo 13, Ohio.

FOR SALE — Tested, unused, Machlett 6C21 tubes for low cost KW, $8 each, FOB. I. O. Ebert, 1810 Linden St., East Lansing, Mich.

FOR SALE — Complete station: CEC ECO-NBFM; WRL Globe King 400B CW only with 20-80 meter coils; DB23 preselector; NC-240D with speaker. Make offer. A. C. Bell, Slickville, Pa.

SELL OR TRADE — Several surplus PW condensers with gear drive, and 0-500 dial, $5.75 pp, approx. 15-128uufd., hi voltage, mfd. National Co. C. W. Low, McDonough, Ga.

FOR SALE — Superior TV11 tube tester, $25; NRI 34 sig. tracer, $25 and 45 VOMA, $15; Eico 320-322 sig. gen., $10; NRI appliance repair course and tester completely wired and in case, $25. F. J. Wood, Box 75, Jeffersonville, N. Y.

TRADE OR SELL — Harvey-Wells senior model converted to 6 meters only, 6146 final, 8 MC xtal, 2E26 tube and all parts new for building 50 MC exciter as shown in handbook, partly wired. Alden Sanford, Jr., 327 Cleburne, West Helena, Ark.

TRADE OR SELL — RCA KCS92 TV complete less cabinet, wall mounting; RCP 705A sig. gen.; portable table radios. Want Weston 983 scope, Precision E300 or Jackson 655 audio oscillator. Chester Benson, 333 So. 5th, Richmond, Ind.

WANTED — Model 108 pocket power supply made by Oak Ridge Products. Cameron Steele, R. 1, Shelbyville, Ind.

WANTED — Military surplus, commercial airborne electronics, all types of lab. quality test equipment and instruments. Charles Littell, 434 Patterson Rd., Dayton 19, Ohio.

FOR SALE — RCA sweep gen., WR-59A and WR-39A TV calibrator, with instruction manuals, l. n., for reasonable offer. E. Schwartz, 5851 Malvern Ave., Philadelphia 31, Pa.

FOR SALE — American D5 dynamic mike, l. n., $12; Revere T-100 tape rec., 3 3/4 ips, exc. cond., $45; 2 GE spkrs. No. 1201A, in portable carrying cases, $20. Harold J. Gabriel, 65-60 Wetherole St., Rego Park 74, N. Y.

FOR SALE — Radio-TV shop. RCA "Judicial" tape recorder, $160; nearly complete stock of 1/2, 1 and 2 watt resistors and receiving tubes. Radio-TV Repair Service, 9 W. Liberty St., Dansville, N. Y.

FOR SALE — Heath: T-3 tracer, $20; CM1 capacity tester, $25; MM1 multimeter, $25; TC-2P tube tester, $32; BE-5 battery eliminator, $39.95. All like new. Eric Olsen, West Main St., Kingsville, Ohio.

FOR SALE — Eico 1040 6 v. battery eliminator and charger, 0-15 v., 0-10 A output, $10 plus shipping. John Frena, Box 98, Mammoth, Pa.

FOR SALE — Rider's Troubleshooters manuals, vols. 13 thru 22, incl. indexes, all l. n., $80. George Gillam, McVeytown, Pa.

TRADE — Hickok 19X crystal controlled microvolt generator and military surplus VOM test set I-179, 20,000 ohm/volt for old U. S. coins. William W. Moore, 278 Main St., West Concord, Mass.

FOR SALE — Superior TV-40 CRT checker; Eico 536 1% resistors multimeter; 5BP1A oscilloscope cathode ray tube. Cash offer for one or all. Arthur Crabb, 7740 Oak St., Kansas City, Mo.

FOR SALE — Electro-Voice 636 mike, GE A1-900 record compensator, GE preamp, RCA tubes, output trans. J. Holloway, 1421 Arch St., Philadelphia 2, Pa.

WANTED — Books: "How to Service Radios with A Oscilloscope" or "How to use CR Oscilloscope in Servicing Radio-TV." William Sharkey, 42-66 Phlox Place, Flushing 55, N. Y.

SELL OR SWAP — Books: Supreme vols. 1, 2, 3, Practical Radio and Electronics course; TV Servicing course; Rider's Repairing TV Receivers by Glickstein; How To Use: Test Probes, Signal and Sweep Generators; Meters, $20 or 7 x 50, 10 x 50, 16 x 50 binoculars. S. T. Jazowski, 22 Seymour St., Montclair, N. J.

FOR SALE — Hallicrafters 38D, $25; Eldico xmitter 75TVI, $35; 80, 40, Eldico AM 40 modulator, $45; TBX 4 transceiver, $25. Swap for 6 meter rig. Metropolitan area. Seymour Kramer, 2851 Sedgwick Ave., Bronx 68, N. Y.

SWAP — Modulation xformer, 1.82:1, turns ratio, pri 15,000 sec. 4250 ohm, 235 ma max. for plate xformer at 600 VDC 235 ma approx. Richard Moss, Box 24, Fontana Dam, N. C.

FOR SALE — Hallicrafter SX-42 communications rcvr., exc. cond., matching R-42 bass reflex reproducer and 25w HT-17 transmitter with coils, modulator and extras. Make offer. John Alescot, 437 Fairmount Ave., Jersey City, N. J.

FOR SALE — Complete ham station: Hallicrafter SX-100 rcvr. with matching spkr., $250; DX-35 xmitter, $45; Johnson VFO 122, $30. Marvin J. Potent, 410 Brighton Beach Ave, Brooklyn, N. Y.

FOR SALE — B & K CRT pix tube rejuvenator and tester model 350, l. n., $25; SECO VT grid circuit tester model GCT-3, in A-1 cond., $7.50. C. Soest, 12092 Kilbourn, Detroit 13, Mich.

WANTED — DX-100. Must be a bargain, describe fully and quote price. Stanley Zuchora, 2748 Meade St., Detroit 12, Mich.

FOR SALE — Precision 10-54 deluxe tube and set tester, latest aluminized finish, l. n., with instruction book, $95 plus shipping. Cas, 85-61 66 Rd.; Forest Hills, N. Y.

WANTED — Philco 7030 dynamic tester. State price and cond. Kenneth Christensen, 120 S. Nance, Minden, Neb.

SWAP — Candler code system A-1 cond., 10 lessons for 1956 Ford radio in good cond. Rupert Freeman, 2108-33 Ave., Meridian, Miss.

WANTED — Will pay up to $50 for SCR-522 rcvr. with power, fine tuning, 4 to 6 ohm output, guaranteed to cover 88 to 148 mcs., or other rcvr. that meets these specifications. P. L. West, 322 Mass. Ave., NE, Washington 2, D. C.

FOR SALE — Electronic Corp. of America FM-TV sweep sig. gen., $30; Heathkit 03 oscilloscope, $25. Both FOB. Leo Mahler, 11631 S. Van Ness Ave., Los Angeles 47, Calif.

WANTED — Metal locator, Fisher, Goldak Gardiner, etc., or home built. Richard Lackner, 2029 Bradley, Chicago 18, Ill.

FOR SALE — Collins ART-13 autotune xmitter, $250. Darrell Hoag, 504 Metropolitan Ave., Hyde Park, Mass.

FOR SALE — Precision sweep gen. E400, l. n., $50; Riders 6-8, 10-12, 14, 15, A-1 cond. all $30; TV 3, $8 l. n.; unused Wilcox-Gay paper bond base recording discs 294-6½" and 120-8". Best offer. James Winebrenner, 713 Locust St., Wrightsville, Pa.

WANTED — Schematic of Porto-Power model 2605 using 1823 vibrator, mfd. by Electronics Laboratories, Inc., Indianapolis, Ind. J. LoRe, 11 Forrest St., Iselin, N. J.

WANTED — Will pay $1 each for single copies of QST, March 1951, Jan. '52, Feb. '53. Must be in perfect cond. Henry C. Jung, 213 North 10th St., Philadelphia 7, Pa.

WANTED — Mobile convertor 40-50 mc, good cond., 6 v. only. James E. Stokes, 4358 Park Ave., Bronx 57, N. Y.

SWAP — Cornell-Dubilier BF50 condenser analyzer in l. n. cond. Bill Dore, 464 Jericho Tpke., Mineola, N. Y.

FOR SALE — Precise 635 uni-audio gen., $15; Jackson TV6-2 sweep marker gen., $145; Hickok 191X microvolt gen., $45. Al Obal, 4165 "J" St., Omaha 7, Neb.

WANTED — All types of receiving and TV tubes. Must be perfect. B. Boiter, Box 685, Freeport, N. Y.

FOR SALE — Livingston binaural arm, $10; 3 GE RPX sapphire cartridges, $3.50; all issues of Audio League reports, $3.50. Eugene Roy, 5 Hillside St., Haverhill, Mass.

WANTED — 2 25w horns with driver complete for outdoor work and 6-12 DC 117 AC amplifier with record player attached, for mobile work. Must be in A-1 shape. Give details price. Bob's Radio and TV Service, Box 37, Wabasso, Fla.

POSITION WANTED — Railroad Radio communication or closed circuit TV. Experience: 30 years part-time radio, 9 years TV shop, 2 years Navy instructor, FCC first class radio telephone license, 21 years telegraph operator. J. B. Faller, Ridgeley, W. Va.

FOR SALE — RCA 44B velocity microphone, response 30-15,000 cycles, exc. cond., $65. H. Ruffalo, 14 Center Ave., Cedar Grove, N. J.

TRADE — Revere T-70163 tape recorder, for commercially built radio xmitter or rcvr. Ken Hegstad, Dickey, N. Dak.

FOR SALE — National NC88 rcvr., less than 10 hours use, $90; Heath AT-1 xmitter, $20, and AC-1 antenna coupler, $10. N. Klock, 227 Fenimore Ave., Uniondale, L. I., N. Y.

TRADE OR SELL — Mobile 6 v, 15w amp with mike and RCA Pict-O-Guide vols 1-3 for Navy 7 x 50 binoculars or equivalent. A. L. Berkebile, R. 1, New Paris, Pa.

SELL OR TRADE — Gonset 2 mtr, communicator II; Precision deluxe E-200C sig. gen. and deluxe 98 VTVM. All perfect working order. Gerald T. Smith, R. 1, Windsor, Pa.

WANTED — DeVry Technical School correspondence course. Charles Heckman, 7519 2 Ave., North Bergen, N. J.

WANTED — 200-A detector tube. Must be in good working cond. and fair price. Raymond Fisher, 627 Fallowfield Ave., Charleroi, Pa.

SWAP — Pilot tuner, Superior TV-30 sig. gen. and TV cross-bar gen. and electronic volt ohm meter model 100 for ham gear. Irving N. Akers, Box 233, Rural Retreat, Va.

FOR SALE — Tel-Instrument Co. wobbulator: type 1200, channels 2-13 push button crystal controlled, audio and video markers, 47 tubes and blower fan. $135 or best offer. Ken Leiser, 284 Highland Rd., Grayslake, Ill.

SELL OR TRADE — University C-12W speaker, adjustable response, up to 30 watts output, unused. Make offer or trade for test equipment. Sommers, 865 W 180 St., New York 33, N. Y.

FOR SALE — HQ 120 rcvr, $120; HRO, coils and power supply, $90; 5 ft. steel rack, $20; pr '813 final amp and dual pwr. supply, Gonset communicator 2 6 v., $145. John A. Kakstys, 18 Hillcrest Terr., Linden, N. J.

SELL OR TRADE — Approved Electronics TV linearity pattern gen, perfect Tele-Check with 8" tube. Need VFO, grid dip meter and PA amplifier. W. H. Bynum, 1111 Ten Eyck St., Jackson, Mich.

SELL OR TRADE — 16mm sound projector; VM 3-speed record changer; 3-way portable radio. Jack Grant, Box 281, Coalgate, Okla.

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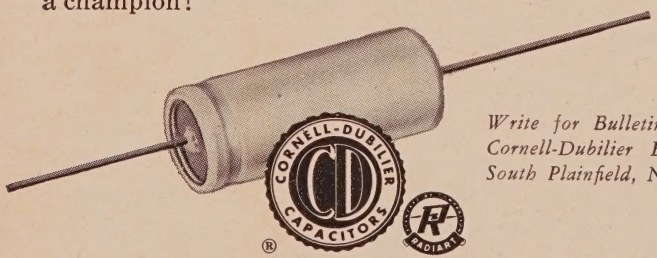

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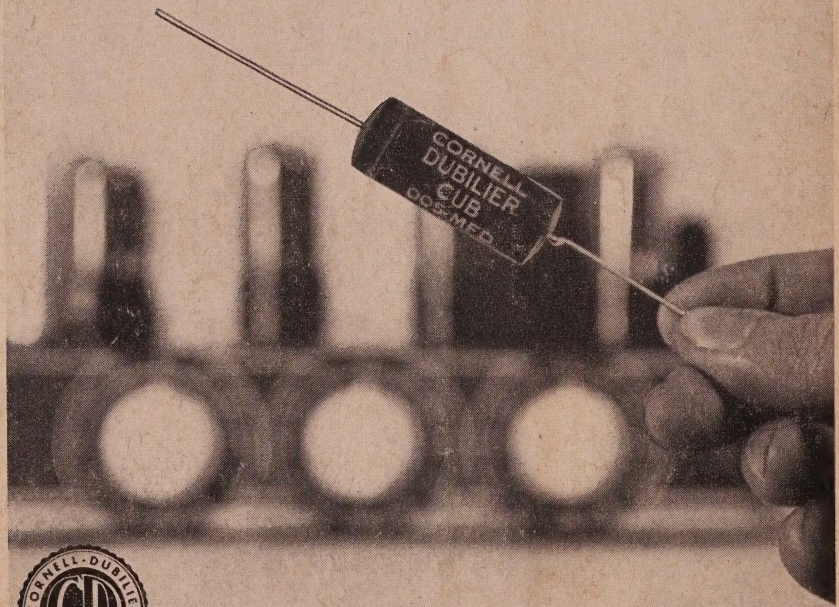

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